Time and Size at Release Experiment: Four Releases of Three Size Categories of Juvenile Coho Salmon from the Capilano Hatchery in the Spring of 1982

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TIME AND SIZE AT RELEASE EXPERIMENT: FOUR RELEASES OF THREE SIZE CATEGORIES OF JUVENILE COHO SALMON FROM THE CAPILANO HATCHERY IN THE SPRING OF 1982

by

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ABSTRACT

Bilton, H. T., R. B. Morley, E. Stone, and D. Brouwer. 1983. Time and size at release experiment: Four releases of three size categories of juvenile coho salmon from the Capilano Hatchery in the spring of 1982. Can. Dat. Rep. Fish. Aquat. Sci. 383: iv + 16 p.

An experiment is currently in progress at the Capilano Hatchery, North Vancouver, B.C., to measure the effects of time and size at release of juvenile coho salmon (Oncorhynchus kisutch) on their subsequent survival, growth, distribution and age at maturity. In the spring of 1982, four releases (May 7, May 28, June 18, and July 9) of juvenile coho salmon each comprising three size groups were released from the Capilano Hatchery, representing a combined total of 153,191 marked and tagged fish. Prior to each release, samples of smolts were obtained for examination for disease, proximate analysis, and sea water challenge tests, and blood plasma sodium analysis. This report provides, in readily accessible form, background information required to assess the results of this experiment. Specific information on lengths, weights, sex compositions, health and ability of released fish to adapt to sea water is provided.

Key words: Capilano, coho, data, size, release time.

RÉSUMÉ

Bilton, H. T., R. B. Morley, E. Stone, and D. Brouwer. 1983. Time and size at release experiment: Four releases of three size categories of juvenile coho salmon from the Capilano Hatchery in the spring of 1982. Can. Dat. Rep. Fish. Aquat. Sci. 383: iv + 16 p.

Une expérience est présentement en cours à la piscifacture de Capilano, à Vancouver Nord (C.-B.), afin de mesurer l'incidence de la taille des saumons cohos (Oncorhynchus kisutch) juvéniles mis en liberté, et du moment choisi pour ce faire, sur leur survie ultérieure, leur croissance, leur répartition et leur âge à maturité. Au printemps de 1982, quatre mises en liberté (7 mai, 28 mai, 18 juin et 9 juillet) de saumons cohos juvéniles, chacune comprenant trois classes de longueur, ont été effectuées à la piscifacture de Capilano. Au total, 153 191 poissons étiquetés et marqués ont été relâchés. Avant chaque mise en liberté, des échantillons de saumoneaux ont été obtenus pour l'examen pathologique, l'analyse immédiate, des tests d'acclimatation à l'eau de mer et l'analyse du sodium dans le plasma sanguin. Le présent rapport fournit, dans une forme facilement accessible, les données fondamentales nécessaires à l'évaluation des résultats de l'expérience. Des données sur la longueur, le poids, la répartition des sexes, l'état de santé des poissons relâchés et leur capacité à s'acclimater à l'eau de mer sont aussi présentées.

Mots-clés: Capilano, coho, données, taille, moment de la mise en liberté.

INTRODUCTION

The purpose of this report is to provide, in readily accessible form, background information required in a current experiment on the effects of time and size at release of juvenile Capilano River coho salmon (Oncorhynchus kisutch) on their subsequent survival, growth, distribution and age at maturity. This report has been divided into three major sections: the first deals with the smolt releases; the second with disease; and the third with blood sodium analysis.

SECTION I. SMOLT RELEASES

MATERIALS AND METHODS

A. Donor Stock and Rearing

A part of the production stock of 1980 brood Capilano eggs collected in the fall were used for the experiment. In an attempt to achieve three sizes of smolts (small, medium, large) three groups of fry were placed on three different feeding regimes in July, 1981. Each group was reared separately in one of three Burrows ponds at the Capilano hatchery until their release the following spring. All the fish were reared at production densities using the normal hatchery water supply and fed Oregon moist pellets (OMP) throughout the rearing period.

B. Experimental Design

Releases of three size categories of juvenile coho were made on each of four dates. For each release, approximately equal numbers of fish were removed from each of the three ponds containing either small, medium, or large fish. These fish were nose-tagged and marked in three equal replicates per size category to give statistical replication. Thus, there were nine distinctly tagged groups at each release, making a total of 36 groups for all four releases. The design was as shown below.

Size Category	May 7	May 28	June 18	July 9
Small	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
Total	12,000	12,000	12,000	12,000
Medium	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
Total	12,000	12,000	12,000	12,000
Large	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
	4,000	4,000	4,000	4,000
Total	12,000	12,000	12,000	12,000

C. Nose-tagging and Marking

All fish were tagged and marked during the spring of 1982. Those released on May 7 were tagged and marked April 19-23. Those released on May 28 were tagged and marked May 10-14. Those released on June 18 or July 9, were tagged and marked May 31-June 4. At each of the first three tagging sessions, approximately 12,000 fish from each of the three ponds holding one of the three size groups of fish were removed, tagged, marked and accumulated and held until release in a single pond. Hence, this single pond at the end of a tagging session contained 12,000 small, 12,000 medium and 12,000 large category fish. The 36,000 fish tagged for the July 9 release, were accumulated and held in an additional pond.

D. Release and Sampling

One thousand marked fish were randomly removed from the release pond on the day of each release. These fish were killed and retained for subsequent examination for tag code, length, weight, and sex. In addition, one or two days before each release, a random sample of 100 tagged fish from

the pond was collected by the Diagnostic Services section (G. Hoskins) for subsequent examination for disease. Two days before release, samples of 25 untagged fish were taken from each of the small, medium, and large ponds by D. Higgs for subsequent proximate analysis. Also, two days before each release a sample of 30 to 49 tagged fish (10 to 16 from each of the small, medium, and large ponds) was collected by C. Clarke for measurement of their ability to adapt to sea-water (Clarke and Blackburn 1977).

Fish were released on May 7, May 28, June 18, and July 9, 1982.

RESULTS

Number, size, and sex ratio results of smolts released

The numbers and tag-codes of released on each date are given in Tables 1-4. Also given in Tables 1-4 are estimates (based on release samples) of mean lengths and weights of fish by sex in each group. A total of 164,026 were tagged, of which 153,191 were estimated to have a tag (based on incidence of marked fish without a tag in release samples). Estimated tag loss by release were: 7 May - 9.7%; 28 May - 0.9%; 18 June - 2.1%; 9 July - 1.6%.

As indicated in Tables 1-4 the coefficients of variation for length and weight were all acceptably low (<30%) and similar between size categories, indicating approximately the same amount of size variability among the fish of the three categories.

Deviations from a 1:1 sex ratio in samples from each release group were compared using the 50% probability test (Langley 1979). In only one of the 36 groups (May 7 release, large size category, tag group 6-16-61) was there a significant difference ($P<0.05$).

For each release, the sex ratios in the total sample from each size category (i.e., replicates combined) were tested for equality using chi-square (Langley 1979). In none of the four releases were there significant differences ($P>.05$) between proportions of males and females in the small, medium, or large categories. Comparison of the sex ratios in the total samples from each release (sizes and replicates combined) indicated total sex ratios did not differ significantly between releases ($P>.05$).

During examination of the smolts for sex two types of males were observed. One group comprised males with no indication of development of the gonads, and the other males exhibiting various stages of development. Results are summarized in Table 5. For smolts from the May 7 release 19 out of 424 (4.5%) were males with developing gonads. Among those from the second, third, and fourth releases (May 28, June 18, and July 9) 0.2%, 0.4% and 3.6% respectively, were males with maturing gonads. It is reasonable to speculate

fish of this type are precocious males that will mature one year early and return as jacks in the fall of 1982. Comparison of the average weights of these fish with that of all males in the sample from each release group (Table 5) indicates a strong tendency for the maturing smolts to be the larger fish from each group. All of the maturing smolts originated either from the medium or large size category in each release.

SECTION II. DISEASE

This section was provided by the Diagnostic Services and summarizes the results of disease examinations of fish from each of the four releases.

METHODS

The following sample of tagged coho smolts were randomly selected from the release ponds on dates indicated.

Case No.	Release Date	Collection Date	Number examined	
			Random	Moribund
82-154	May 7/82	May 6/82	100	-
82-189	May 28/82	May 27/82	100	4
82-230	June 18/82	June 17/82	100	10
82-257	July 9/82	July 7/82	100	6

A. Sampling Procedures

(i) Random samples

(1) 100 fish were randomly selected by dip net from different areas in each pond.

(2) Fish were examined internally and externally for gross signs of pathology and infectious diseases.

(3) Kidney tissue was streaked aseptically onto Tryptic Soy Agar (TSA) for the detection of bacterial pathogens.

(4) Gram stained kidney tissue was examined for the detection of bacterial and parasitic agents.

(5) As a general indicator of health, microhematocrit values were collected on the first 25 fish in each example.

(6) Liver and kidney tissue was collected for histopathogical examination of the first 25 fish in each sample.

(ii) Moribund samples

(1) If available, moribund or fresh dead fish (to a maximum of 10) were sampled from each pond.

(2) The sampling procedure was the same as for random fish, but omitting the collection of microhematocrit values and histological samples.

(3) In random samples a very low incidence of infectious diseases can often not be detected, while examinations of moribund and/or fresh dead fish may show the presence of a bacterial pathogen more readily.

RESULTS

A. Random Samples

In the May 28 and July 9 release groups one fish each was found to have bacterial kidney disease (BKD). No other bacterial pathogens were found.

A clouding of one or both corneas was found in a total of 87 fish. The distribution was as follows: 7 May - 23 fish; 28 May - 7 fish; 18 June - 11 fish; 9 July - 46 fish. Also, in each of the last 3 samples, 3/100 fish had 1 physically damaged eye. The microhematocrit values were: 7 May - Average 41.6%, range 35-48%; 28 May - average 44.4%, range 18-50%; 18 June - average 44.3%, range 37-51%; 9 July - average 43.8%, range 39-51%. Histology: All kidney sections were normal. Two fish of the 7 May release showed slight liver inflammation, possibly due to a protozoan infection. Slight liver vacuolation was seen in 2% of the fish.

B. Moribund Samples

The causative agent of bacterial kidney disease was detected in 1 fish from the 28 May release group sample (n=4), 5 fish from the 18 June release group sample (n=10) and 2 fish from the July 9 release group sample (n=6). In 2 fish from 28 May group sample, eyes were found to be damaged. In the 9 July group sample, 2 fish had cloudy corneas, 1 fish had a cloudy lens and 3 had damaged eyes.

CONCLUSIONS

(1) In most cases pond losses were probably due to BKD or physical eye damage.

(2) Disability due to corneal clouding is probably very slight.

(3) With very few exceptions, micorhematocrit values were within the normal range.

SECTION III. BLOOD PLASMA SODIUM ANALYSIS

This section was provided by C. Clarke. Table 6 summarizes the results of the analysis of plasma sodium after 24-hr exposure to seawater. Lower sodium levels indicate a greater ability to adapt. There was relatively little change in adaptability during the period from the first to fourth release time. The trend for all size groups was for a decline in adaptability from late April to early July. This is in contrast to the pattern observed in the 1981 experiment where performance increased to a maximum in late May and then declined.

ACKNOWLEDGMENTS

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REFERENCES

Clarke, W. C. and J. Blackburn. 1977. A seawater challenge test to measure smolting of juvenile salmon. Fish. Mar. Serv. Div. Tech. Rep. 705: 11 p.

Langley, R. 1979. Practical statistics, simply explained. Pan Books Ltd., Cavaye Place, London SW10 9PG, 400 p.

Table 1. Numbers of tagged coho smolts in the nine groups released at Capilano Hatchery on May 7, 1982. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length (mm)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-16-15	3,711	small	105.41	9.06	53	105.40	8.29	42	105.41	8.68	95	103.64-107.18	8.24
8-16-56	3,763	small	107.33	7.32	55	105.78	8.88	60	106.52	8.17	115	105.01-108.03	7.67
8-16-57	4,024	small	108.98	8.55	51	106.22	7.07	62	107.47	7.86	113	106.00-108.93	7.31
8-16-58	3,860	medium	115.18	9.14	44	111.54	8.25	61	113.07	8.78	105	111.37-114.76	7.76
8-16-59	4,157	medium	114.49	10.75	45	113.33	8.54	48	113.89	9.64	93	111.91-115.88	8.46
8-16-60	3,244	medium	115.16	8.69	55	114.19	9.02	57	114.67	8.83	112	113.02-116.32	7.70
8-16-61	4,175	large	121.32	8.66	37	121.05	7.06	59	121.16	7.67	96	119.60-122.71	6.33
8-16-62	4,160	large	120.22	9.21	41	120.60	9.03	50	120.43	9.06	91	118.54-122.32	7.53
8-16-63	3,673	large	122.19	8.23	43	121.63	8.43	38	121.93	8.28	81	120.09-123.76	6.79
Total	34,767				424			477			901		

Table 1 (cont'd)

Tag Code	Number tagged fish released	Size group	Weight (g)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-16-15	3,711	small	12.84	3.07	53	12.58	2.66	42	12.72	2.88	95	12.13-13.31	22.68
8-16-56	3,763	small	13.26	2.61	55	12.88	3.61	60	13.06	3.17	115	12.48-13.65	24.24
8-16-57	4,024	small	13.80	3.43	51	12.67	2.51	62	13.18	3.00	113	12.62-13.74	22.77
8-16-58	3,860	medium	16.49	3.74	44	15.23	3.40	61	15.76	3.58	105	15.06-16.45	22.76
8-16-59	4,157	medium	16.37	4.57	45	15.81	3.65	48	16.08	4.11	93	15.24-16.93	25.54
8-16-60	3,244	medium	16.69	3.80	55	16.06	3.88	57	16.37	3.84	112	15.65-17.09	23.46
8-16-61	4,175	large	19.34	3.93	37	19.14	3.80	59	19.22	3.83	96	18.44-19.99	19.94
8-16-62	4,160	large	18.63	3.94	41	18.66	4.19	50	18.64	4.05	91	17.80-19.49	21.75
8-16-63	3,673	large	19.59	4.06	43	19.13	4.03	38	19.37	4.03	81	18.48-20.26	20.81
Total	34,767				424			477			901		

Note: The first number in the tag cod indicates agency, the second data 1, and the third data 2.

Table 2. Numbers of tagged coho smolts in the nine groups released at Capilano Hatchery on May 28, 1982. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length (mm)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-17-02	4,501	small	107.22	9.08	60	106.29	9.00	62	106.74	9.01	122	105.13-108.36	8.44
8-17-03	3,848	small	106.86	8.05	49	104.22	8.47	50	105.52	8.33	99	103.86-107.19	7.89
8-17-04	4,518	small	106.44	7.44	48	106.02	7.98	54	106.21	7.69	102	104.70-107.73	7.24
8-17-05	4,435	medium	116.19	8.65	58	115.04	8.37	68	115.57	8.48	126	114.07-117.07	7.34
8-17-06	4,390	medium	114.92	8.43	62	116.16	8.07	64	115.55	8.24	126	114.09-117.07	7.13
8-17-07	4,122	medium	116.46	7.90	65	113.61	9.86	49	115.24	8.87	114	113.59-116.88	7.70
8-17-08	4,526	large	121.65	15.35	46	122.60	10.04	43	122.11	12.99	89	119.37-124.85	10.64
8-17-09	4,591	large	123.29	8.26	48	122.44	9.00	50	122.86	8.61	98	121.13-124.58	7.01
8-17-10	4,381	large	124.72	8.54	58	122.24	10.00	53	123.54	9.31	111	121.79-125.29	7.53
Total	39,317				494			493			987		

Table 2 (cont'd)

Tag Code	Number tagged fish released	Size group	Weight (g)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-17-02	4,501	small	12.81	3.38	60	12.59	3.26	62	12.70	3.30	122	12.10-13.29	26.03
8-17-03	3,848	small	12.77	2.60	49	12.07	2.92	50	12.42	2.77	99	11.86-12.97	22.35
8-17-04	4,518	small	12.72	2.65	48	12.39	2.76	54	12.55	2.70	102	12.02-13.08	21.51
8-17-05	4,435	medium	17.06	3.63	58	16.43	3.39	68	16.72	3.50	126	16.10-17.34	20.96
8-17-06	4,390	medium	16.26	3.51	62	16.96	3.58	64	16.62	3.55	126	15.99-17.24	21.36
8-17-07	4,122	medium	16.84	3.60	65	15.89	3.90	49	16.43	3.74	114	15.73-17.12	22.80
8-17-08	4,526	large	20.27	3.49	46	20.05	4.65	43	20.17	4.08	89	19.31-21.03	20.21
8-17-09	4,591	large	19.95	4.08	48	19.44	4.20	50	19.70	4.13	98	18.87-20.52	20.96
8-17-10	4,381	large	20.42	3.84	58	19.94	4.68	53	20.19	4.25	111	19.39-20.99	21.05
Total	39,317				494			493			987		

Note: The first number in the tag code indicates agency, the second data 1, the third data 2.

Table 3. Numbers of tagged coho smolts in the nine groups released at Capilano Hatchery on June 18, 1982. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length (mm)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-20-37	4,524	small	106.57	7.42	53	110.37	9.11	60	108.58	8.54	113	106.99-110.18	7.87
8-20-38	4,428	small	110.04	6.79	52	108.79	7.65	47	109.44	7.20	99	108.01-110.88	6.58
8-20-39	4,182	small	111.10	8.86	60	107.65	5.55	52	109.50	7.67	112	108.06-110.94	7.01
8-20-40	4,514	medium	120.08	8.85	48	118.78	6.86	59	119.36	7.81	107	117.87-120.86	6.54
8-20-41	4,526	medium	120.67	7.99	63	120.39	6.93	46	120.55	7.53	109	119.12-121.98	6.24
8-20-42	4,282	medium	119.86	9.18	49	120.29	6.68	55	120.09	7.92	104	118.54-121.63	6.60
8-20-43	4,599	large	128.83	8.85	47	125.63	7.08	52	127.15	8.09	99	125.54-128.76	6.36
8-20-44	4,556	large	128.71	8.40	48	127.42	6.55	43	128.09	7.57	91	126.52-129.67	5.91
8-20-45	4,264	large	127.04	10.65	51	128.23	8.94	66	127.71	9.69	117	125.93-129.48	7.59
Total	39,817				471			480			951		

Table 3 (cont'd)

Tag Code	Number tagged fish released	Size group	Weight (g)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N		
8-20-37	4,524	small	12.90	2.57	53	13.94	3.42	60	13.45	3.08	113	12.88-14.03	22.93
8-20-38	4,428	small	13.76	2.78	52	13.23	2.78	47	13.51	2.77	99	12.96-14.06	20.53
8-20-39	4,182	small	14.18	3.04	60	12.89	2.03	52	13.58	2.69	112	13.08-14.08	19.80
8-20-40	4,514	medium	18.29	4.07	48	18.10	3.12	59	18.18	3.56	107	17.50-18.87	19.60
8-20-41	4,526	medium	18.37	3.68	63	19.01	3.17	46	18.64	3.47	109	17.98-19.30	18.63
8-20-42	4,282	medium	18.39	3.94	49	18.67	2.99	55	18.54	3.45	104	17.87-19.21	18.62
8-20-43	4,599	large	22.70	4.93	47	20.83	3.27	52	21.72	4.23	99	20.88-22.56	19.48
8-20-44	4,556	large	22.49	4.16	48	21.97	3.77	43	22.24	3.97	91	21.42-23.07	17.84
8-20-45	4,264	large	21.79	4.76	51	22.25	4.56	66	22.05	4.64	117	21.20-22.90	21.02
Total	39,875				471			480			951		

Note: The first number in the tag code indicates agency, the second data 1, the third data 2.

Table 4. Numbers of tagged coho smolts in the nine groups released at Capilano Hatchery on July 9, 1982. Mean lengths and weights by sex, of smolts sampled at release are given.

Tag Code	Number tagged fish released	Size group	Length (mm)									95% Confidence limits	Coeff. variation
			Male			Female			Male and Female				
			$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N		
8-17-11	4,473	small	110.91	9.13	75	111.07	8.62	70	110.94	8.85	145	109.53-112.44	7.98
8-17-12	4,462	small	109.00	8.84	47	109.65	8.48	54	109.35	8.61	101	107.65-111.05	7.88
8-17-13	4,272	small	108.98	8.86	62	108.47	7.15	66	108.72	8.00	128	107.32-110.12	7.36
8-17-14	4,460	medium	120.40	9.06	63	119.02	8.19	58	119.73	8.65	121	118.18-121.29	7.22
8-17-15	4,462	medium	120.77	7.51	44	121.35	8.07	60	121.11	7.81	104	119.59-122.62	6.45
8-18-14	4,028	medium	121.38	9.77	61	118.88	9.49	73	120.01	9.66	134	118.36-121.66	8.05
8-18-15	4,243	large	126.38	9.31	55	126.17	7.85	58	126.27	8.55	113	124.68-127.87	6.77
8-18-31	4,245	large	129.64	7.83	28	125.89	7.52	36	127.53	7.82	64	125.58-129.48	6.13
8-19-15	4,587	large	129.92	9.87	40	126.91	8.82	47	128.30	9.38	87	126.30-130.30	7.31
Total	39,232				475			522			997		

Table 4 (cont'd)

Tag Code	Number tagged fish released	Size group	Weight (g) Male $\bar{x}$	Male SD	Male N	Female $\bar{x}$	Female SD	Female N	Male and Female $\bar{x}$	Male and Female SD	Male and Female N	95% Confidence limits	Coeff. variation
8-17-11	4,473	small	14.41	3.30	75	14.68	3.31	70	14.54	3.30	145	14.00-15.08	22.68
8-17-12	4,462	small	13.79	3.49	47	14.21	2.99	54	14.01	3.22	101	13.38-14.65	23.00
8-17-13	4,272	small	13.83	3.35	62	13.88	2.99	66	13.86	3.15	128	13.31-14.41	22.76
8-17-14	4,460	medium	19.16	4.50	63	18.49	3.56	58	18.84	4.08	121	18.11-19.57	21.64
8-17-15	4,462	medium	18.80	3.30	44	19.69	4.01	60	19.31	3.74	104	18.58-20.04	19.35
8-18-14	4,028	medium	19.56	4.69	61	18.34	4.26	73	18.90	4.49	134	18.13-19.66	23.76
8-18-15	4,243	large	21.73	4.20	55	21.28	3.73	58	21.50	3.96	113	20.76-22.23	18.41
8-18-31	4,245	large	22.64	3.29	28	21.22	4.06	36	21.85	3.78	64	20.90-22.79	17.31
8-19-15	4,587	large	23.38	5.52	40	21.97	4.82	47	22.62	5.17	87	21.51-23.72	22.87
Total	39,232				475			522			997		

Note: The first number of the tag cod indicates agency, the second data 1, the third data 2.

Table 5. The number, percent and mean weight of maturing male smolts in the four releases from the Capilano Hatchery in 1982.

Tag Code	Release date	Size group	No. non-maturing ♂'s in sample	Maturing males			Percent maturing ♂'s in sample	$\bar{x}$ weight all ♂ smolts (g)
				No.	$\bar{x}$ weight (g)	SD		
8-16-56		small	54	1	12.95	-	1.8	13.26
8-16-57		small	50	1	13.68	-	1.9	13.80
8-16-58		medium	41	3	20.63	4.94	6.8	16.19
8-16-60		medium	50	5	19.46	1.85	9.1	16.41
8-16-61		large	34	3	20.20	3.25	8.1	19.26
8-16-62		large	40	1	24.81	-	2.4	18.48
8-16-63		large	38	5	20.61	2.10	11.6	19.45
Total for release[a]			405	19			4.5	
8-17-06	May 28	medium	62	1	22.19	-	1.6	16.26
Total for release[a]			493	1			0.2	
8-20-40	June 18	medium	48	1	20.99	-	2.0	18.29
8-20-41		medium	63	1	15.51	-	1.6	18.37
Total for release[a]			469	2			0.4	
8-17-11	July 9	small	74	1	19.49	-	1.3	14.41
8-17-12		small	46	1	23.13	-	2.1	13.79
8-17-13		small	61	1	22.53	-	1.6	13.83
8-17-14		medium	58	5	24.78	9.65	7.9	19.16
8-17-15		medium	41	3	22.33	0.75	6.8	18.80
8-18-14		medium	59	2	26.54	-	3.3	19.56
8-18-15		large	54	1	27.87	-	1.8	21.73
8-18-31		large	26	2	23.73	-	7.1	22.64
8-19-15		large	39	1	25.93	-	2.5	23.38
Total for release			458	17			3.6	

[a]Includes tag-codes not having maturing males. Only tag-codes which did contain maturing males are listed individually above.

Table 6. Blood sodium levels after 24 h exposure to sea water for three size groups of coho smolts in each of four releases from Capilano Hatchery in 1982.

Date released	Date tested	Size group	Observations after challenge: N	Length (mm) $\bar{x}$	Length (mm) S.E.	Blood Sodium (meq/L) $\bar{x}$	Blood Sodium (meq/L) S.E.	Weight (g) $\bar{x}$	Weight (g) S.E.	Condition factor $\bar{x}$	Condition factor S.E.
-	April 20	Small	17	10.3	.2	166.3	1.8	10.5	.5	.93	.01
		Medium	15	10.8	.1	172.1	2.3	12.0	.4	.96	.01
		Large	14	12.1	.2	165.1	1.4	17.2	.9	.97	.01
		ALL	46	11.0	.1	167.8	1.2	13.0	.5	.95	.01
May 7	May 7	Small	13	11.0	.2	168.3	1.8	12.5	.7	.93	.03
		Medium	10	11.2	.2	169.9	1.9	13.8	.7	.98	.01
		Large	17	12.6	.3	171.4	2.7	19.9	1.3	.98	.02
		ALL	37	12.1	.2	173.2	1.4	16.0	.7	.87	.01
June 18	June 18	Small	14	11.3	.2	172.9	2.1	12.4	.7	.84	.01
		Medium	10	12.7	.2	177.0	3.3	18.0	.8	.88	.02
		Large	11	12.6	.3	176.7	2.0	19.0	1.0	.95	.03
		ALL	36	12.3	.2	175.2	1.4	16.0	.7	.88	.02
July 9	July 9	Small	14	11.3	.3	175.7	3.6	12.4	1.1	.82	.01
		Medium	11	12.2	.2	168.5	3.6	15.7	.8	.84	.01
		Large	11	12.8	.2	175.8	5.4	18.3	1.1	.86	.02
		ALL	36	12.1	.2	173.5	2.4	15.2	.7	.84	.01

April 20 sample taken from separate S-M-L rearing ponds (fish untagged). All other samples taken from release pond 3-5 days before release, most were tagged and size categories were determined by tag reading.

No mortalities resulted from seawater exposure.

Weight and condition factor may have been affected by dehydration.